

Benthic Total Maximum Daily Load Study for Accotink Creek

Public Meeting
July 26, 2010



Presentation Outline

- TMDL Background
- Accotink Creek Impairment History
- Stressor Analysis



Why are we here?

**Accotink Creek does not meet
Virginia's Water Quality
Standards.**



- How do we know standards aren't being met?
- Why doesn't Accotink Creek meet standards?
- What is being done to correct the problem?

How do we know that Accotink Creek doesn't meet Water Quality Standards?

- Perform physical, biological, and chemical monitoring on water bodies throughout the state
- Monitor parameters such as:
 - ? pH
 - ? Temperature
 - ? Dissolved Oxygen
 - ? Biological Community
 - ? Bacteria
 - ? Nutrients
 - ? Fish Tissues
 - ? Metals/Toxic Pollutants

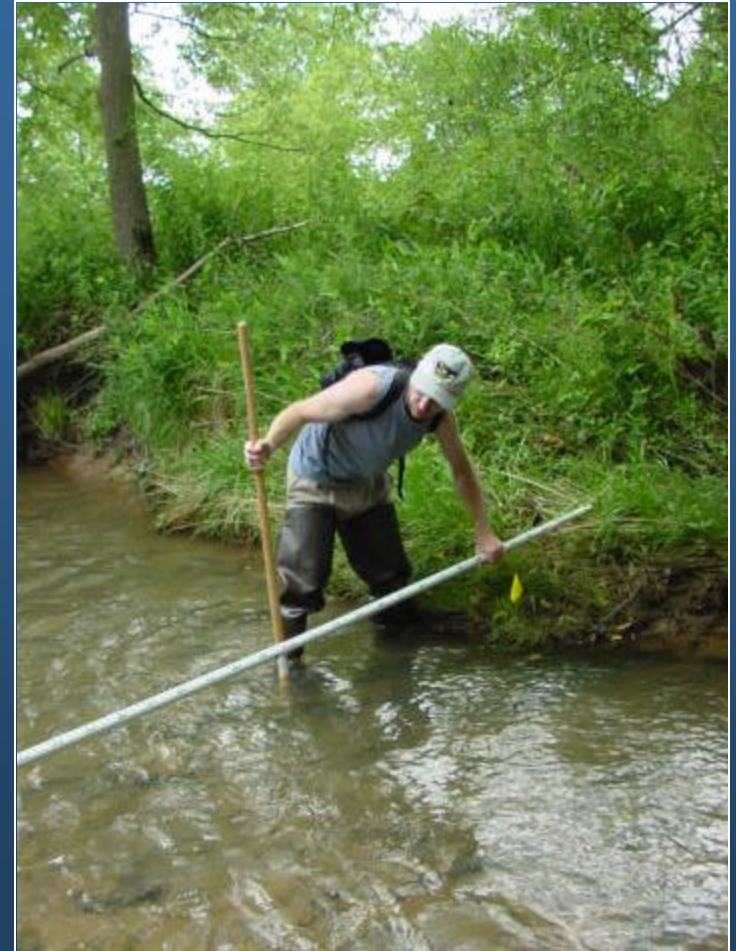


What do we do with the monitoring data that is collected?

Compare the data collected to the water quality standards

Water Quality Standards:

- Regulations based on federal and state law
- Set numeric and narrative limits on pollutants
- Consist of designated use(s) and water quality criteria to protect the designated uses



Designated Uses

- Recreational
- Public Water Supply
- Wildlife
- Fish Consumption
- Shellfish
- Aquatic Life



The attainment of the aquatic life use is evaluated by testing for the health of the benthic macroinvertebrate community, as well as for parameters such as DO and pH.

Accotink Creek

Benthic Impairments

Impaired Use	Impairment Cause	Impairment Length	Year Impairment First Listed	Upstream Limit	Downstream Limit
Aquatic Life	Benthic Macroinvertebrates	7.35 miles	1996	Confluence with Calamo Branch	Start of the tidal waters of Accotink Bay
Aquatic Life	Benthic Macroinvertebrates	0.85 miles	2008	Confluence of an unnamed tributary, located in the upstream corridor of Ranger Park	Confluence with Daniels Run





What happens when a water body doesn't meet water quality standards?

- Waterbody is listed as “impaired” and placed on the 303(d) list.
- Once a water body is listed as impaired, a Total Maximum Daily Load value must be developed for that impaired stream segment to address the designated use impairment.
- TMDL Studies are required by law:
 - 1972 Clean Water Act (CWA)
 - 1997 Water Quality Monitoring Information and Restoration Act (WQMIRA)

What is a TMDL ?

*Total **M**aximum **D**aily **L**oad*

TMDL = Sum of WLA + Sum of LA + MOS

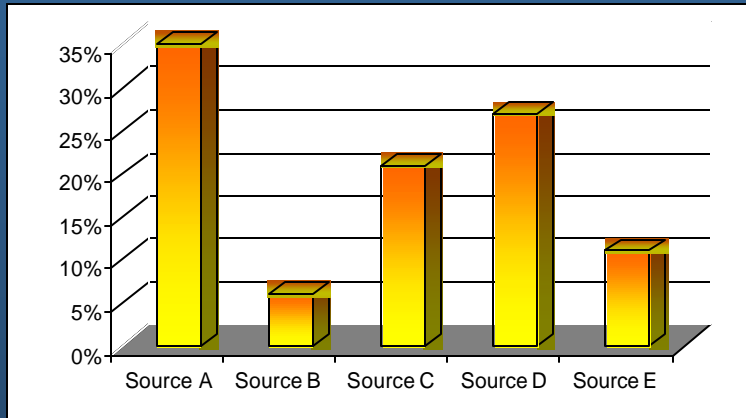
Where:

TMDL	=	Total Maximum Daily Load
WLA	=	Waste Load Allocation (point sources)
LA	=	Load Allocation (nonpoint sources)
MOS	=	Margin of Safety

TMDL Development Methodology



1. **Benthic TMDL: Determine most likely stressor, then identify sources of that stressor.**



2. Calculate the amount of pollutant entering the stream from each source type.
3. Enter available data into a computer model. Model simulates pollutant loadings into the watershed.
4. Use the model to calculate the pollutant reductions needed, by source, to attain Water Quality Standards.

5. Allocate the allowable loading to each source and include a margin of safety.

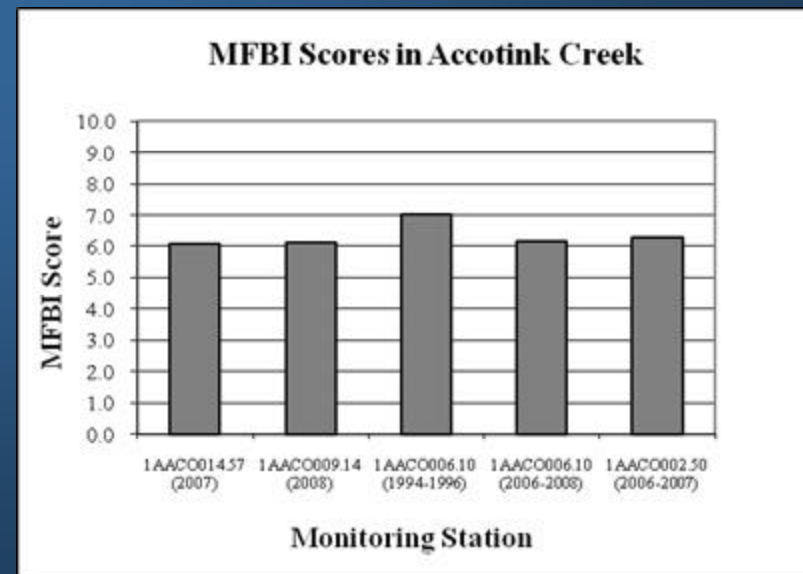
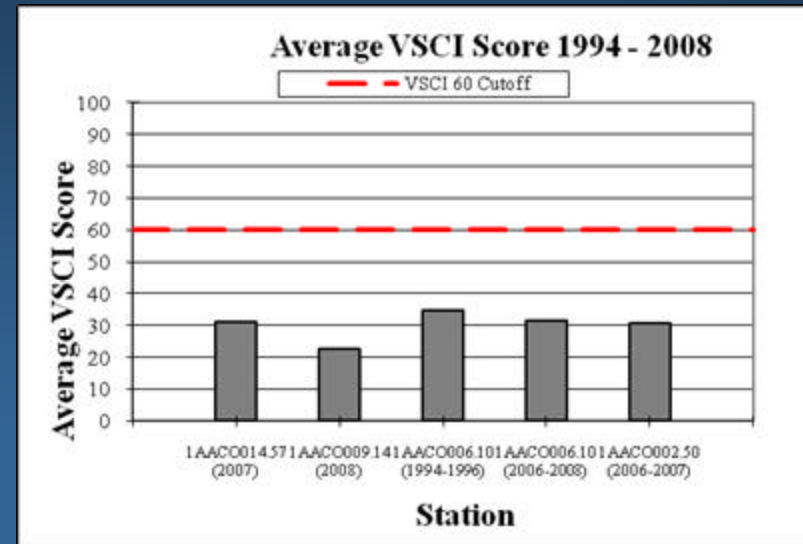
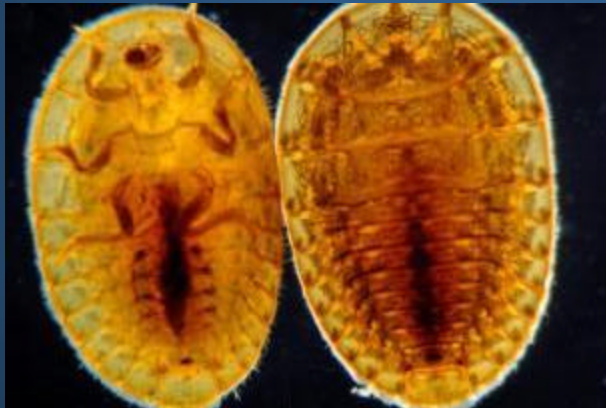


Project History

- TMDL Study initially began in 2007
- December 2007 – Revised timeline for project completion
- EPA assumes the lead in TMDL Development – May 2009
- Technical Advisory Committee Meetings
 - December 2008, August 2009, January 2010
- Public Meetings
 - September 2009
 - July 2010
- Public Comment Period on Draft Report:
July 5, 2010 to August 4, 2010

Biological Monitoring Data

- VSCI scores in the Accotink Creek have been consistently low. Overall average of 33.9 (1994 – 2008)
- Habitat Scores remain in the 6-7 range and organism density continues to be low.
- Dominant organisms at these stations are from the families Hydropsychidae and Chironomidae (considered to be more tolerant).





Data Used in Stressor Identification

1. Biological and Habitat Assessment Data

- Collected between 1996 and 2008 at four VA DEQ monitoring stations

2. Water Quality Data

- Instream water quality data (field parameters, nutrients, solids, metals, and organic contaminants)
- Collected between 1974 and 2008 at eight VA DEQ monitoring stations

3. Toxicity Testing (EPA Region 3 laboratory in Wheeling, West Virginia):

- Using water samples from two VA DEQ monitoring stations
 - a) Acute toxicity testing
 - b) Chronic toxicity testing

4. Discharge Monitoring Reports (DMR)

5. Relative Bed Stability Studies (RBS)

6. Biologist's field notes and observations (VA DEQ)

Stressor Identification

Non-Stressors*
pH
Temperature
Dissolved Oxygen
Instream Metals
Possible Stressors**
Nutrients (Nitrogen and Phosphorus)
Toxicity
Metals and Organic Contaminants in Fish Tissue
Most Probable Stressors***
Urban Runoff and Sedimentation (Instream Erosion)

* Non-Stressors - Stressor without water quality exceedances

** Possible Stressors - Stressor with data indicating possible links to benthic impairment.

*** Most Probable Stressors - Stressor with conclusive data linking it to the poor health of the benthic community.

Relative Bed Stability Analysis

Mean Particle Size Percentile in Accotink Creek		
Station ID	Log of Mean Particle Size	Percentile ¹
1AAC004.84	1.17	73 rd
1AAC006.10 (2006)	1.57	98 th
1AAC006.10 (2008)	1.35	79 th
1AAC009.14	1.44	83 rd
¹ Based on Statewide Data		

Percent Fines Percentile in Accotink Creek		
Station ID	Percent Fines	Percentile ¹
1AAC004.84	18%	15 th
1AAC006.10 (2006)	19%	18 th
1AAC006.10 (2008)	24%	20 th
1AAC009.14	19%	18 th
¹ Based on Statewide Data		

LRBS Percentile in Accotink Creek		
Station ID	LRBS	Percentile ¹
1AAC004.84	-0.04	88 th
1AAC006.10 (2006)	0.55	98 th
1AAC006.10 (2008)	0.56	95 th
1AAC009.14	0.72	99 th
¹ Based on Statewide Data		

Slope Percentile in Accotink Creek		
Station ID	Slope	Percentile ¹
1AAC004.84	0.52	30 th
1AAC006.10 (2006)	0.22	14 th
1AAC006.10 (2008)	0.17	11 th
1AAC009.14	0.22	14 th
¹ Based on Statewide Data		

Most Probable Stressor

Sedimentation and Urban Runoff (Instream Erosion):

- Low habitat assessment scores for epifaunal substrate, sedimentation, embeddedness, bank stability, etc.
- RBS Study Results:
 - Altered hydrology has led to a scoured, eroded stream which leaves behind a higher than expected median particle size.
 - Fine sediments transported out of the upper reaches of Accotink Creek. Sediment that erodes from the banks of Accotink Creek is deposited further downstream in the Accotink watershed, closer to the tidal boundary.
- DEQ Field Biologists noted impacts from nonpoint source and storm sewer runoff were degrading habitat and potentially inhibiting the health of the aquatic community.
- The impervious surfaces within the urban areas have increased the overland flow, high flow events, and channel erosion.
- Flow frequency analysis (City of Fairfax, July 2005) showed that the frequency of high stream flow events increased and the baseflow decreased with increased imperviousness.

High urban runoff leading to excessive instream erosion are considered to be the most probable stressors impacting the biological community in Accotink Creek.

CONTACTS

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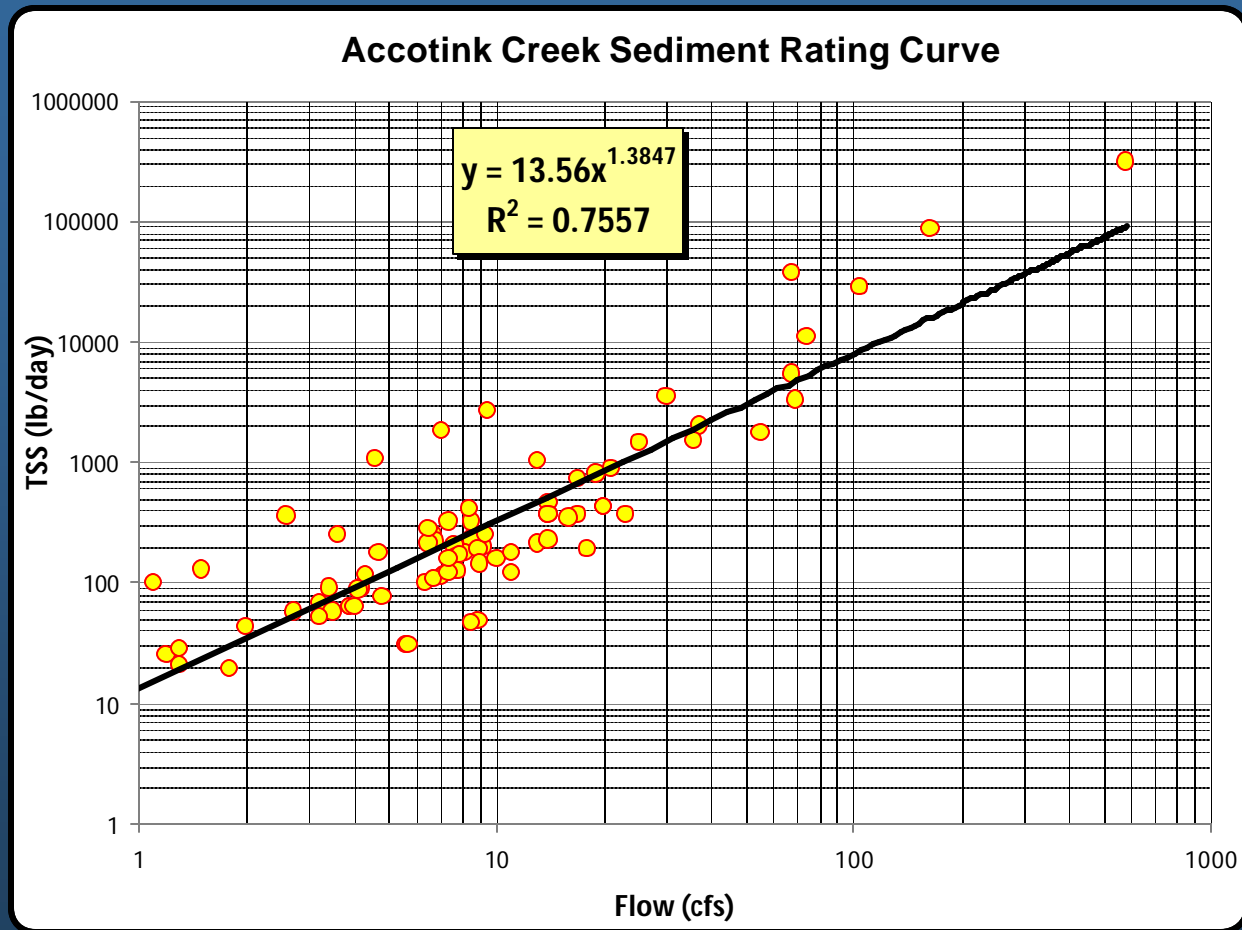
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Pollutant of Concern = Sediment



Sediment ? Flow Relationship



Accotink Creek TMDL Approach

- Reductions for a surrogate (stormwater runoff) are established to achieve reductions for the pollutant (sediment)
- Stormwater is an appropriate surrogate because the pollutant (sediment) load in Accotink Creek is a function of the amount of stormwater runoff generated in the Accotink Creek watershed
- This TMDL establishes a limit for the amount of stormwater runoff that Accotink Creek can receive during storm events.

Regulatory Authority

- **CWA 304(a)(2):** “The Administrator ...shall develop and publish...information on the factors necessary to restore and maintain the chemical, physical, and biological integrity of all navigable waters . .
- **CWA 304(f)(2)(F):** “The Administrator...shall issue. . .information including . . . processes, procedures, and methods to control pollution resulting from . . . changes in the movement, flow, or circulation of any navigable waters or ground waters...”
- **CWA 402(p):** sets forth the authority to regulate discharges composed entirely of stormwater from industrial and municipal stormwater systems. Section 402(p) treats dischargers of stormwater associated with industrial and construction activity and certain municipal dischargers as point sources and subject to NPDES permits.

Regulatory Authority

- CWA § 502(6) definition of **pollutants**:

“dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water”
- CWA § 502(19) definition of **pollution**:

“man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water”
- Flow is a type of **pollution**
- Federal Regulations at 40 CFR 130.7:
 - Identify list of **pollutants** to be regulated, and
 - Develop TMDLs for **pollutants** identified

Regulatory Authority

- EPA implementing guidance for identification of impaired waters:
 - If impairment is caused by **pollution** and not **pollutants**, no TMDL is needed
 - If impairment is caused by **pollution** that is associated with **pollutants**, a TMDL is needed
- If excess stormwater flow causes impairment due to associated **pollutants** (like sediment, toxics, etc), a TMDL is required
- EPA believes a TMDL can be expressed in terms of stormwater flow volume or flow reduction, where “flow” is used as a surrogate for **pollutants** associated with stormwater discharges

Regulatory Authority

- Code of Virginia § 62.1-11(F):
“The quality of state waters is affected by the quantity of water and it is the intent of the Commonwealth, to the extent practicable, to maintain flow conditions to protect instream beneficial uses and public water supplies for human consumption”

Agenda

- Overview of the Technical Approach
- Attainment Streams
- Selection of Hydrologic Target
- TMDL Allocations
- Questions

TMDL Development

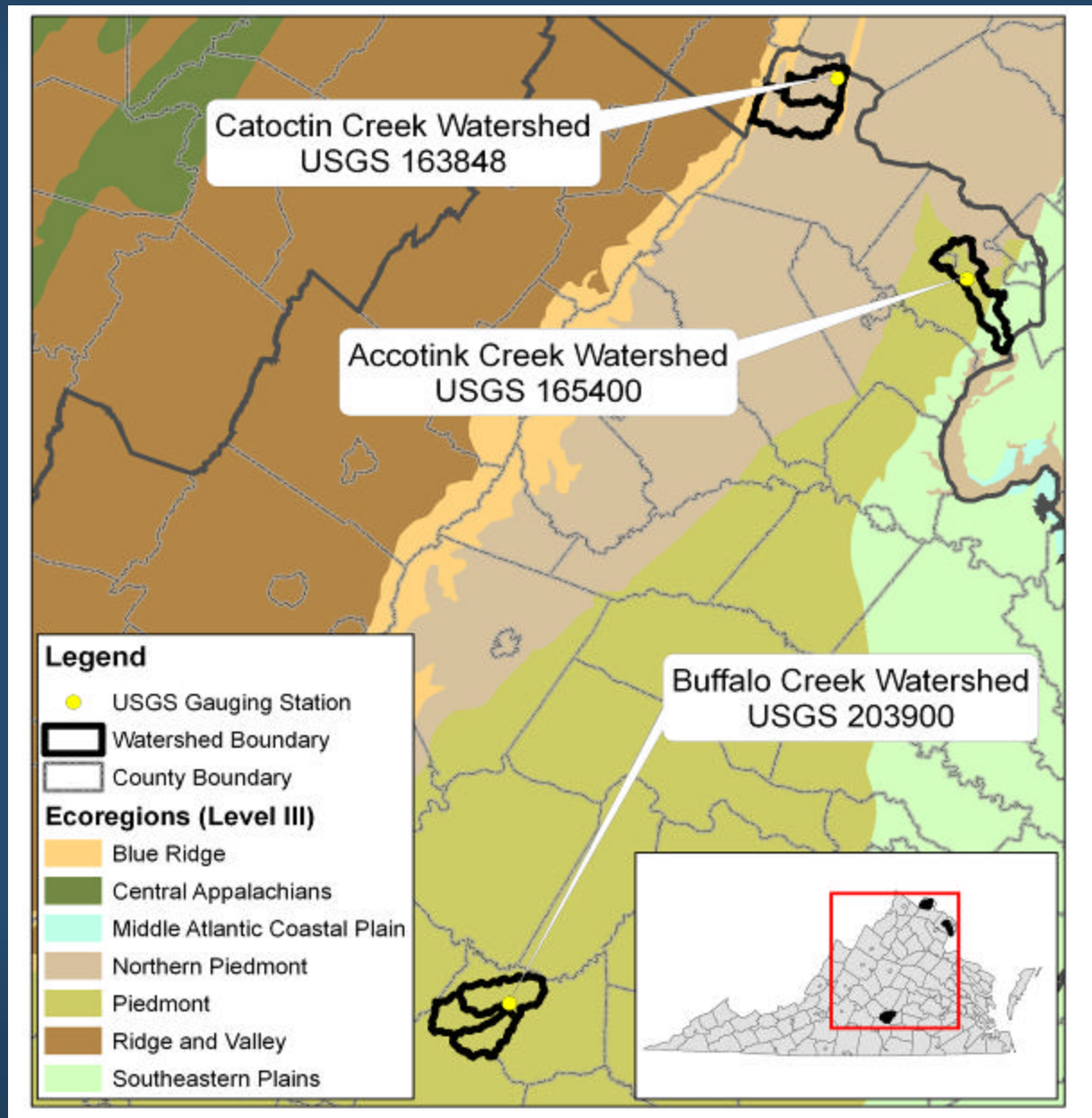
Based on the Attainment Watershed Approach

1. Selection of Appropriate Attainment Streams where the VADEQ Aquatic Life Criteria are currently met
2. Development of Flow Durations Curves (FDC) for Accotink Creek and the Attainment Streams
3. Identification of the Hydrologic Endpoints
4. Estimation of the Existing-Conditions Stormwater Flow In Accotink Creek and the TMDL Stormwater Flow
5. Development of the TMDL Allocations

Criteria Used in the Selection of Attainment Streams

- Existing biological monitoring data indicating that the stream is not impaired
- Existing USGS Gage Station located in close proximity to a DEQ Biological Station
- Biological Station is located in either the Piedmont or Northern Piedmont eco-region (Most of the drainage area of the Accotink Creek watershed is within these 2 Ecoregions)
- Drainage Area at the USGS Station has to be greater than 10 mi² and less than 100 mi² (Accotink drainage area is 24 mi² at the gauging station and about roughly 51 mi² at the outlet of the impairment). This generally corresponds to the same stream order as Accotink Creek.

Selection of Attainment Streams



Attainment Streams

Stream Name	Ecoregion	USGS Station	Period of Flow Record	Drainage Area (mi²)
Buffalo Creek	Piedmont	02039000	1946-2009	69.6
Catoctin Creek	Northern Piedmont	01638480	1971-2009	89.5
Accotink Creek	Northern Piedmont, Piedmont, Southeastern Plain	01654000	1947-2009	23.9

Attainment Streams Biomonitoring Data

Virginia SCI Scores

Collection Period	Buffalo Creek	Catoctin Creek
Fall 1994	-	70.5
Spring 1995	-	73.1
Fall 1995	-	66.2
Spring 1996	-	67.0
Fall 1996	-	63.1
Spring 1997	-	72.8
Fall 1997	-	75.5
Spring 1998	-	74.7
Fall 1998	-	69.7
Spring 1999	-	74.0
Fall 1999	-	71.1
Spring 2000	-	71.7

Collection Period	Buffalo Creek	Catoctin Creek
Fall 2000	-	68.5
Spring 2001	-	69.6
Fall 2001	67.1	
Spring 2002	63.5	75.48
Fall 2002	69.0	68.74
Spring 2003	-	54.99
Fall 2003	-	66.7
Fall 2005	77.8	-
Spring 2006	61.0	-
Fall 2006	80.8	-
Spring 2008	70.6	61.4
Fall 2008	68.8	-

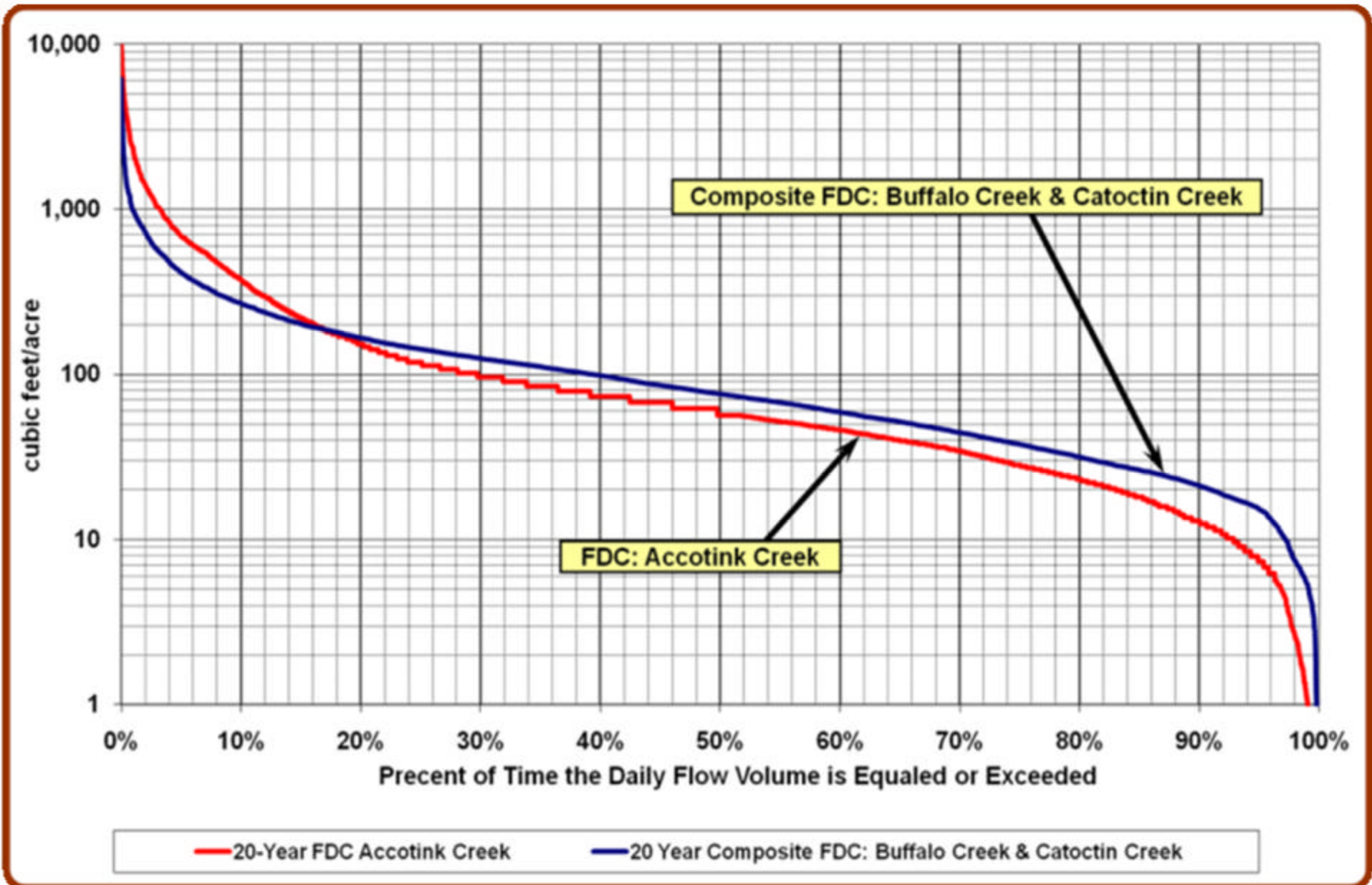
Flow Duration Curves

- The hydrologic target is identified using cumulative frequency curves, called Flow Duration Curves (FDCs)
- FDCs depict the percentage of time that specific daily flows are equaled or exceeded at sites where continuous records of daily flow are available
- FDCs have been widely used for quantifying and studying the effects of urbanization on streams, since they respond to changes in a watershed's hydrologic characteristics
- FDCs are constructed using observed flow data that is readily available

Flow Duration Curves

- Flow duration curves are developed for Accotink Creek (impaired stream) and a composite FDC representing the attainment streams (Buffalo Creek, and Catoctin Creek)
- In order to compare the FDCs and identify the endpoint, the FDC are developed using to flow per unit area (cubic feet/acre-day)
- The composite Attainment streams FDC combines and uses the average unit-area flows for Buffalo Creek and Catoctin Creek
- FDCs are developed using a similar period of record; a 20-year period of flow record (November 1989 through November 2009) is used to develop the FDCs

Flow Duration Curves



Selection of Hydrologic Targets

- The Accotink Creek TMDL establishes targets for high and low flows
 - The high-flow target is the 1year-24 hour stormwater flow
 - The low-flow target is the 95th percentile flow (flows are equaled or exceeded 95% of the time)

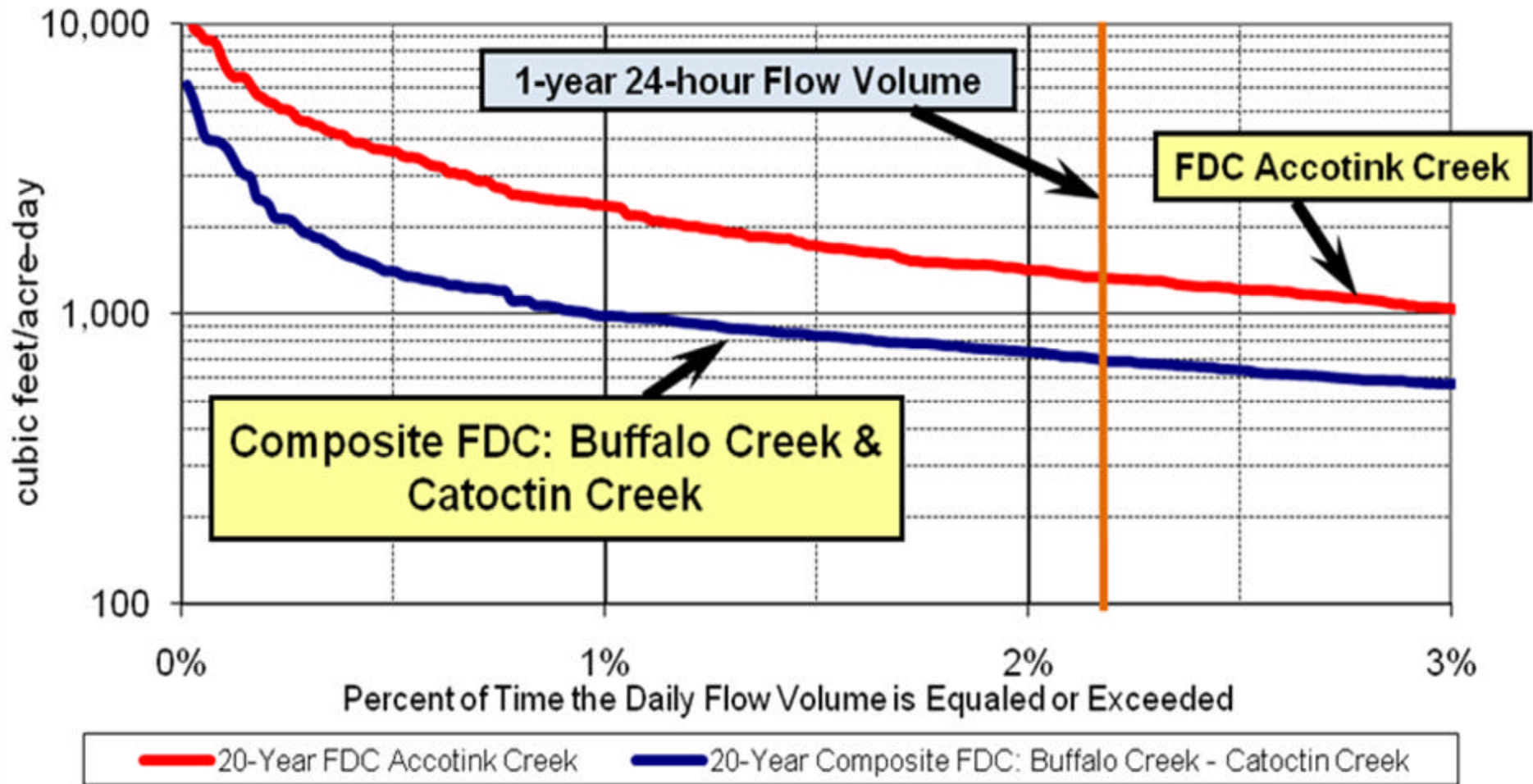
Reductions to the high flow target will result in increased infiltration and groundwater recharge and will ultimately result in achieving the low-flow target

Selection of Hydrologic Targets

The 1 year-24 hour flow was selected as the high flow target:

1. Stream channel morphology is more influenced by frequent (1- to 2-year) flow events; “bankfull” or “near bankfull” flows; than by large flood events (Leopold 1994, Hollis 1975)
2. The 1 year-24 hour flow is generally considered the *channel forming* flow for small streams
3. Targeting the *channel forming* flow helps directly reduce key channel altering events that produce large amounts of sediment within the stream system and damage the aquatic habitat
4. Virginia has proposed design specifications for stormwater management measures that are largely based on controlling the 1 year-24 hour flow

1 year-24 Hour Hydrologic Target



1 year-24 Hour Hydrologic Target

- The 1 year-24 hour stormwater flow is estimated at 234 cfs using the last 20 year of flow record in Accotink Creek (November 1989 through November 2009) and corresponds to:
 - A unit-area flow of 1,321.7 ft³/acre-day using the Accotink Creek FDC, and
 - A unit area flow of 639.8 ft³/acre-day using the attainment-streams composite FDC

Estimation of Overall TMDL Stormwater Flow Reduction for a one-year, 24- hour flow				
Accotink Creek Flow Volume (ft ³)	Accotink Creek Unit-Area Flow Volume (ft ³ /acre-day)	Non-impaired Composite Unit-Area Flow Volume (ft ³ /acre-day)	Flow Volume Reduction (ft ³ /acre-day)	Overall Reduction
20,217,600	1,321.7	681.8	639.9	48.4%

Overall, the magnitude of the one-year 24-hour stormwater flow in the Accotink Creek watershed must be reduced by 48.4% in order to meet the established TMDL endpoints

Existing Conditions Flow Distribution

- Distribution of the 1year-24 hour flow existing-conditions in Accotink Creek was based on:
 - A land-use based approach to estimate the relative stormwater flow contribution from the land areas
 - A Runoff Coefficient Approach to estimate the existing stormwater contribution from each land use category
 - A runoff coefficient (Rc) represents the fraction of precipitation that appears as runoff and is expressed as a constant value between zero and one

$$\text{Runoff Coefficient (Rc)} = 0.05 + 0.91 * \text{Fraction of Imperviousness}$$

Accotink Creek Existing Conditions Unit Area Flow

1 Year-24 Hour Flow

Accotink Creek Existing Conditions Unit-Area Flow Volume (one-year, 24-hour flow)				
Fairfax County Land Use Type	Acres	Percent Imperviousness*	Runoff Coefficient	Flow (ft ³ /acre-day)
High Density Residential	3,003	31	0.332	155.7
Medium Density Residential	7,655	25	0.278	331.6
Institutional	1,464	24	0.268	61.3
Industrial	1,949	38	0.396	120.4
High Intensity Commercial	757	52	0.523	61.8
Low Intensity Commercial	843	42	0.432	56.9
Transportation	4,566	27	0.296	210.8
Estate Residential	383	21	0.241	14.4
Golf Course	686	9	0.132	14.1
Low Density Residential	3,286	22	0.250	128.3
Open Space	5,715	15	0.187	166.4
Total	30,307	-	-	1,321.7

* Percent Imperviousness Derived using GIS data provided by Fairfax County

Basis for Developing the Allocations

- 10% of the existing stormwater flow from all land uses was used to calculate the LA assigned to nonpoint sources
- WLAs are based on the assumption that stormwater runoff from 90% of all land uses in the watershed drain to permitted storm sewer systems
- Equal reductions to the existing stormwater flow (LA and WLA) contribution from all the land use categories except for the Open Space land use category

TMDL Waste Load Allocations (WLA)

Waste Load Allocations	Land Use Category	Acres	Existing conditions (ft ³ /acre-day)	Allocation (ft ³ /acre-day)	Reduction
	High Density Residential	2,702.7	140.1	62.51	55.4%
	Medium Density Residential	6,889.5	298.4	133.14	55.4%
	Institutional	1,317.6	55.2	24.63	55.4%
	Industrial	1,754.1	108.4	48.35	55.4%
	High Intensity Commercial	681.3	55.6	24.82	55.4%
	Low Intensity Commercial	758.7	51.2	22.84	55.4%
	Transportation	4,109.4	189.7	84.62	55.4%
	Estate Residential	344.7	13.0	5.79	55.4%
	Golf Course	617.4	12.7	5.67	55.4%
	Low Density Residential	2957.4	115.5	51.53	55.4%
	Open Space	5,143.5	149.7	149.74	0.0%
	Total	27,276	1,189.5	613.6	48.4%

This WLA is disaggregated to develop specific allocations for each MS4 and Stormwater Permit (Industrial, General, etc..)

TMDL Load Allocations (LA)

Load Allocations (Lands not discharging to an MS4 - 10% of the existing stormwater flow)	Land Use Category	Acres	Existing conditions (ft ³ /acre- day)	Allocation (ft ³ /acre- day)	Reductio n
	High Density Residential	300.3	15.6	6.95	55.4%
	Medium Density Residential	765.5	33.2	14.8	55.4%
	Institutional	146.4	6.1	2.7	55.4%
	Industrial	194.9	12.0	5.4	55.4%
	High Intensity Commercial	75.7	6.2	2.76	55.4%
	Low Intensity Commercial	84.3	5.7	2.54	55.4%
	Transportation	456.6	21.1	9.40	55.4%
	Estate Residential	38.3	1.4	0.64	55.4%
	Golf Course	68.6	1.4	0.63	55.4%
	Low Density Residential	328.6	12.8	5.73	55.4%
	Open Space	571.5	16.637	16.64	0.0%
Total		3,031	132.2	68.2	48.4%

Disaggregation of the WLA

- Set aside 5% of the total TMDL for construction stormwater permits. The future construction activities are assumed to occur in all land use categories including the Open Space category
- Industrial stormwater permits: Individual, general stormwater, and concrete facilities
- MS4 Permits (VDOT, Fairfax County, City of Fairfax, Town of Vienna, Fort Belvoir Military Reservation)

Summary of Existing and Allocated Stormwater Flows

Summary of Existing and Allocated Stormwater Flows					
Source	Allocation Category	Acres	Existing Conditions (ft ³ /acre-day)	Allocation (ft ³ /acre-day)	Percent Reduction
Point Sources (WLA)	MS4 Permits	25,237.7	1,086.1	551.9	49.2%
	Construction Stormwater Permits	1,515.4	76.4	34.1	55.4%
	Industrial Stormwater Permits	674.8	34.6	15.44	55.4%
WLA Totals		27,427.8	1,197.2	601.42	49.8%
Nonpoint Sources (LA)		2,879.2	124.5	63.74	48.8%
Grand Total		30,307	1,321.7	665.16	49.7%

MS4 Permittees Wasteload Allocations

MS4	Acres	Reduction to the one-year, 24-hour Flow
Fairfax County	20,071.3	48.4%
City of Fairfax	2,848.0	53.2%
Town of Vienna	945.3	53.2%
Fort Belvoir	873.6	41.8%
VDOT	433	55.4%
NOVA Community College	66.7	54.9%
Total	25,237.7	49.2%

Individual and Industrial Stormwater Permits

Facility Name	Permit Number	Drainage Area (acres)	WLA Reduction of 1 year 24 hour Flow
Individual VPDES Stormwater Permits			
Fairfax Terminal Complex	VA0001872	106.4	55.4%
Kinder Morgan Southeast Terminals	VA0001945	17.9	55.4%
Motiva Enterprises LLC	VA0001988	10.9	55.4%
Motiva Enterprises LLC - Fairfax	VA0002283	4.6	55.4%
Quarles Petroleum - Newington	VA0057380	3.6	55.4%
Industrial Stormwater General Permits			
Canada Dry - Springfield	VAR050988	4	55.4%
SICPA Securink Corporation	VAR051042	7.5	55.4%
Connector Bus Yard	VAR051047	6.3	55.4%
United Parcel Service	VAR051053	2	55.4%
US Postal Service - Merrifield	VAR051066	1.8	55.4%
Fort Belvoir Building 1442	VAR051080	430.7	55.4%
Shenandoahs Pride Dairy	VAR051100	7.3	55.4%
Federal Express Corporation	VAR051109	3.9	55.4%
G and L Metals	VAR051134	1	55.4%
Rolling Frito Lay Sales LP	VAR051565	4.1	55.4%
National Asphalt Paving Corporation	VAR051719	2.7	55.4%
Jermantown Maintenance Facility	VAR051770	10.8	55.4%
Newington Maintenance Facility	VAR051771	25	55.4%
DVS - Alban Maintenance Facility	VAR051772	4.7	55.4%
HD Supply - White Cap	VAR051795	0.2	55.4%
United Parcel Service - Newington	VAR051863	13.7	55.4%
Concrete Facilities Stormwater General Permits			
Newington Concrete Corporation	VAG110046	1.2	55.4%
Virginia Concrete Company	VAG110069	4.5	55.4%
Total		674.8	55.4%

TMDL Equations

Stormwater TMDL for Accotink Creek (ft ³ /acre-day)			
TMDL	Load Allocation	Wasteload Allocation	Margin of Safety
665.2	63.7	601.4	Implicit/Explicit

Stormwater TMDL for Accotink Creek (Reduction to the one-year- 24-hour flow)			
TMDL	Load Allocation	Wasteload Allocation	Margin of Safety
49.7%	48.8%	49.8%	Implicit/Explicit

Questions & Comments

Comment period ends August 4, 2010
Submit comments to:

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